REMARKS

Applicants file this Response to the Office Action dated September 9, 2004. Claims 1-28 are currently pending in the application. In the outstanding Office Action, the examiner has rejected 1-28 under 35 U.S.C. §102 as allegedly being anticipated by Ortyn et al. (U.S. Patent 5,841,124). Applicants respectfully traverse the rejection and request reconsideration of the claims in view of the following remarks.

The standard for anticipation under 35 U.S.C. §102(b) is one of strict identity. An anticipation rejection requires a showing that each limitation of a claim be found in a single reference, *Atlas Powder Co. v. E.I. DuPont de Nemours & Co.*, 224 U.S.P.Q. 409, 411 (Fed. Cir. 1984). The current grounds for rejection of the claims can not stand because Ortyn et al. fail to disclose each and every limitation of the independent claims and therefore there can be no anticipation of the claims under 35 U.S.C. §102(b).

The disclosure by Ortyn et al. is directed to an automated method for checking cytological system autofocus integrity. According to Ortyn et al., the automated method includes the steps of checking focus illumination integrity, checking focus camera Modulation Transfer Function, checking focus camera position integrity, and checking closed loop accuracy.

As such, Ortyn et al. is directed to a quality control system for validating automated microscopy systems for autofocus performance. The cytological system autofocus integrity checking system disclosed by Ortyn et al. evaluates the optical performance of a microscopy based system and, as disclosed, is not another autofocus system in and of itself. In addition, Ortyn et al. disclose and teach a practical means for conducting a performance evaluation, but do not disclose the autofocus algorithm and implementation itself. For example, Ortyn et al. do not disclose the use of the first order Gaussian derivative in a real-time image driven autofocus system.

Ortyn et al. disclose a digital band-pass filter (see Fig. 15, numeral 404/406; col. 18, line 13). A digital band-pass filter can include almost anything, and the choice may be from thousands of options. Performance of autofocus is affected by the type of filter selected.

The selection of a suitable filter that provides optimal performance during autofocus using different microscopic modes is one of the problems that the present invention seeks to

overcome. (see application page 1-4). In contrast to Ortyn et al., the present invention includes a digital gradient filter, which is a high-pass filter of a specific type, that provides improved performance over other types of filters, such as the digital band-pass filter of Ortyn et al. This feature of the present invention is recited in, for example, independent claim 1, step 2: "applying a digital gradient filter . . ."; independent claim 11, line 4: ". . . the autofocus mechanism having a digital gradient filter . . ."; independent claim 22, line 4: ". . . a digital gradient filter . . .".

Furthermore, the claimed digital gradient filter includes a smoothing filter where the spatial extent (smoothing size) of the filter is settable. This feature is also recited in independent claims 1, 11, and 22. For example, independent claim 1, line 7: ". . . a smoothing operation having a settable spatial extent . . ."; independent claim 11, lines 6-7: ". . . a smoothing operation having a settable spatial extent . . ."; independent claim 22, lines 5-6: ". . . a smoothing operation having a settable spatial extent . . .".

In contrast, the filter 404 in Fig. 15 of Ortyn et al. does not disclose smoothing with settable size. In addition, the cytological system autofocus integrity checking apparatus disclosed by Ortyn et al. smoothes the focus score, that is the output F+ and F- as shown at the right of Fig. 15. The method disclosed by Ortyn et al. has drawbacks as compared with the claimed invention of the present application with respect to, for example, noise sensitivity. The method disclose by Ortyn et al. requires noise sensitivity to calibrate and threshold (see Ortyn et al. at col. 20). In contradistinction, the claimed invention of the present invention does not require such an effort, as noise is already averaged inside the claimed filter before constructing the focus score. This feature provides an autofocus method that is robust against confounding factors common in microscopy, such as noise, optical artifacts, and dust on the preparation surface.

Ortyn et al. disclose band-pass filtering 404, energy operator 408, and smoothing the function score afterward. The combination of band-pass filtering 404, energy operator 408, and smoothing afterward as disclosed by Ortyn et al. is structurally and mathematically different from high-pass filtering with smoothing, and afterward energy operator, as recited in the claims of the present application. For example, the extra step of noise cancellation and calibration disclosed and required by Ortyn et al. is not necessary in the present invention.

Hence, independent claims 1, 11, and 22 of the present invention are not anticipated

by Ortyn et al. because the Ortyn et al. reference does not disclose all of the limitations recited in those claims. In addition, claims 2, 4-10, 12, 14-20, 23 and 25-28, which depend direct or indirectly from independent claims 1, 11, and 22, are also allowable over Ortyn et al. for the reasons stated above with respect to independent claims 1, 11, and 22.

Regarding independent claims 3, 13, and 24, each of these claims includes features not disclosed by Ortyn et al. Independent claim 3 is representative and recites in step 2:

> applying a digital filter to at least some of the pixel values of the first digital image to obtain a focus score for the first digital image; wherein the digital filter is defined by a mathematical smoothing function having a negative and positive lobe around the origin thereof, the mathematical smoothing function having only one zero crossing and being limited in spatial extent in that it extends over a distance smaller than or equal to the image size and extends at least over three pixels either side of a pixel whose value is being filtered

Independent claims 13 and 24 recite the same or substantially similar features.

Applicants respectfully disagree with the Examiner allegations that the above features are disclosed by Ortyn et al. Claim 3 is directed to a method of autofocus applying a digital filter, claim 13 is directed an optical instrument having a digital filter, and claim 24 is direct to an auto-focusing mechanism for an optical instrument having a digital filter. The digital filter in each claim is defined by a mathematical smoothing function having a negative and a positive lobe around origin thereof.

Ortyn et al. does not disclose this feature. It is respectfully submitted that the examiner has misapplied and confused the disclosure and teaching of Ortyn et al. For example, the Office Action appears to considers Fig. 13 to be a "focus score" curve, being the output F+,F- and normalized difference (F+ - F-)/(F+ + F-) of the focus subsystem (see right-hand side of Fig. 15). After that, the Office Action appears to consider the curve to be inside the filter 404 of Fig. 15. This is incorrect because Fig. 13 has nothing to do with the focus filter function 404.

Compared to the present application, the curves of Ortyn et al. Fig. 13 appear to be similar to application Fig. 4a-f and application Fig 5, which represent the focus score curves for the system of the present application. However, they have absolutely nothing to do with the size and shape of the focus filter 404 in Fig. 15 of Ortyn et al, nor with the limitations

recited in the claims.

Also, the focusing system disclosed by Ortyn et al. has a target range between 7 and 19 pixels. However, as stated above with respect to claim 1, this relates to smoothing after focus energy determination 408 in Fig. 15. This is different than the method and apparatus claimed in independent claims 3, 13, and 24 of the present invention.

Therefore, independent claims 3, 13, and 24 of the present invention are not anticipated by Ortyn et al. because the Ortyn et al. reference does not disclose all of the limitations recited in those claims. In addition, claim 21, which depends from independent claim 13, is also allowable over Ortyn et al. for the reasons stated above with respect to independent claim 13.

Further, claim 4, step 4, recites:

> continue moving the object relative to the optical instrument along the optical axis thereof in the same direction in accordance with steps 1 to 3 to acquire at least three digital images and first to third focus scores associated therewith

This step is another difference and innovation with respect to existing autofocus systems and the automated system for checking autofocus integrity of Ortyn et al. Ortyn et al. describe a z-pan focus: "A z-pan focus is performed under control . . . at step 132. A z-pan focus refers to a focusing procedure in which a sample is scanned in the z-axis, that is along the optical axis, preferably through the focal plane of the optical system." (Ortyn et al. at column 15, lines 18-23).

Then, Ortyn et al. continue by describing: "At predetermined increments during the scan, . . .," which implies a "stop and go" mechanism to capture at these ***predetermined*** positions. In contrast, the present invention claims a timing methodology: the present invention sets the microscope motor to travel from above focus to below focus, without any further control on positioning (see claim 4, step 4, which recites continued movement of the object relative to the optical instrument). At the same time, the present invention asynchronously start capturing images (see claim 4, step 4, which recites acquiring at least three digital images and first to third focus scores). The claimed invention of the present application uses the timing of the captured images and assumes linear movement along the z-axis to connect each captured image to a z-position, from which the claimed method and

apparatus derive the optimal focus position. Hence, the method and apparatus of the claimed invention do not have predetermined positions, but completely adapt to the (more or less random) times at which images are captured.

This feature is not disclosed by Ortyn et al. and therefore claim 4 is also allowable for this additional reason.

Withdrawal of the rejection of pending claims 1-28 under 35 U.S.C. §102(b) is respectfully requested in view of the above remarks.

apparatus derive the optimal focus position. Hence, the method and apparatus of the claimed invention do not have predetermined positions, but completely adapt to the (more or less random) times at which images are captured.

This feature is not disclosed by Ortyn et al. and therefore claim 4 is also allowable for this additional reason.

Withdrawal of the rejection of pending claims 1-28 under 35 U.S.C. §102(b) is respectfully requested in view of the above remarks.

CONCLUSION

In view of the foregoing amendments and remarks, Applicants submit that the above-identified application is in condition for allowance. Early notification to this effect is respectfully requested.

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